February 27, 2003

ATTN: Mr. Gary Flamm
California Energy Commission
Sacramento, CA

RE: 2005 Title 24 Standard's Bi-level Outdoor Lighting Provision

Dear Gary:

I did some "unscientific" research on the Title 24 standard's 2005 provision for bi-level outdoor lighting. My aim was to verify that what I have experienced over the years with controlling outdoor lighting is congruent with the 2005 standard's intent and my own position on this matter. What I am finding supports what I have experienced all along; bi-level (or reduced level) outdoor lighting control is a very common practice. Although my sample size is somewhat small, I feel the results would not change much if it were larger.

Electrical engineers I polled do mostly commercial office, institutional and school electrical design. I did not speak with any that do retail design. I have other data to support retail outdoor lighting design that is shared later in this document. All of the engineers said they do outdoor building, site and parking lot lighting design on a regular basis. They indicated that bi-level outdoor lighting is the general rule. All engineers said it was uncommon for them **not** to design with bi-level lighting. One cited bank ATM's as the only place that came to mind where it was not done, and this was done to meet the owner's requirements and not a standard or code requirement. None indicated bi-level control was done to meet local or other governing agency requirements. They went on to say bi-level outdoor lighting control is a result of prudent and best practice design to conserve energy. It is widely accepted and often required by the owners.

When asked what percentage of parking lot lighting is designed to be left on all night, I was surprised to learn that it was not somewhere below 50% but much lower. All engineers said below 25% and one said only 15% of the lighting is designed to be left on all night. The remaining larger percentage is designed to shut-off at sometime during the night when the buildings are not occupied. One engineer indicated that some schools require all lighting to be shut-off sometime during the night because they have less vandalism and problems when all lighting is turned off. Some indicated that lighting directly attached to or next to buildings is less likely to use bi-level control. Building lighting is more likely to remain on all night.

When asked how they circuited or controlled parking lot lighting, all indicated they circuit the bi-level control so that one head in a selected multi-head pole fixture would remain on. They do not circuit all fixture heads on a pole to be on all night, but rather select a single fixture head on specific poles according to lighting and parking lot layout. Usually every 4th or 5th or 6th fixture head is left on all night, the rest are designed to shut off early. Where only single head pole

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fixtures are used, they'll leave selected poles on, and turn others off on a pole fixture by pole fixture basis. None said they would leave all heads in a multi-head pole on all night. Rather, they leave a selected fixture head on selected poles (not every pole) on all night, and turn the remainder of the fixture off. For example, if a parking lot had two headed fixtures on a pole, late at night one may find only one fixture head on in every other pole.

As for the liability issue, all engineers said they designed to footcandle levels to meet local jurisdiction requirements with all lighting on. All point by point footcandle designs are figured with all fixtures being on. When asked if they ever looked at footcandle point by points with bi-level control (with only ~25% of the lighting on) all said "never". They only designed to meet footcandle levels with all lighting on. All felt that reducing outdoor lighting may pose a liability risk, but none had ever been involved with or known of a case where lack of lighting level caused an actual liability issue. Some said they work closely with the owner to make sure that the owner is satisfied with the lighting level, both with all lights on and when the lighting level is reduced. Two engineers mentioned that "after all, the owner can always choose when or even if he will shut the lighting off, we just make sure it is possible to do so".

When asked about the additional cost for doing bi-level outdoor lighting, all said they could not give specific numbers, but all felt it had to be minimal compared to the cost of trenching, piping, wiring and backfill to get power to the lighting fixtures in the first place. One said, "I can't believe that the added cost of bi-level outdoor lighting control would even hit the radar screen its so small".

I also spoke with a number of contractors to understand what their experience with outdoor lighting has been. Some of the contractors were the largest electrical contractors in the Bay Area. Their answer to how often they experience bi-level outdoor lighting varied. Some said all the time and would be surprised if it wasn't designed that way. One said, "some of the time". A smaller contractor said, "not too often". When bi-level lighting was designed on a project, they indicated a similar number of fixtures being left on all night as the engineers that were surveyed. One stated as low as 15% of the fixtures would be left on all night, others, 20 - 25%. No one ever mentioned anything above 25%.

When asked about the incremental cost, responses were: "minimal", or "can't even figure it because it is too small". "The hard work is done, it's just pulling an extra wire and maybe another contactor and channel on a time clock". One contractor actually ran their estimating program to determine the cost of an additional wire pull in the conduit that might be needed for bi-level control. He said, "when you figure the cost to trench, install conduit, pull wire and back fill, the cost of adding another wire to the run is 6.2% of the overall cost. This does not seem much of an increase and considering bi-level outdoor lighting is done today so frequently, it's not really an added cost, but a cost already included.

I contacted a number of retail mall property owners and facility managers representing no less than 300 retail properties collectively. All said they do bi-level outdoor lighting control on most of their properties. One manager said they did on all of their properties. Another manager indicated they shut off a portion of their lighting on about 80% of his properties. He went on to say he'd like to do bi-level control on more properties had they been circuited that way when first constructed. In some cases, because the outdoor lighting was not circuited for bi-level control, they just turn off all the outdoor lighting after business hours. Not all managers could give an exact percentage of lighting that shut-off early except that it was at least 50%. One manager, representing several hundred properties, said they leave on less than 10% of the outdoor lighting at night. When asked about the concern of liability with shutting off the lighting,

the manager with several hundred retail sites said this is a concern for them. But, he has never seen a liability problem himself. He said they keep some minimal lighting on all night by the store entrances for employees to accommodate this issue. From their perspective, after the last employee leaves, their liability is over. Anyone else on the property after these hours is considered trespassing.

I did a cursory look at a block of 800 plus retail stores where my company has provided outdoor lighting controls. I could not get data on the percentage of lighting left on all night. What I did learn was of this group of 800 or so retail stores, about 10% of them actually control the parking lot and exterior lighting at their stores. The outdoor lighting of the other 90% are controlled by the property or mall landlord. Of the 10% where the retail store owners control the lighting, ALL are designed for bi-level lighting control. Almost all sites shut lighting down within one to two hours of the store closing. A rare few, usually in areas where lighting levels are a concern, they keep all lighting on all night. Even in these cases, some lighting may be shut off early if desired later because they were designed for bi-level control.

After a late flight into the San Jose Airport, I took the opportunity to look at office and retail outdoor lighting on buildings along the corridor from the airport up I-680 to I-580 out through the Livermore Valley. I observed and gathered data from over 50 different sites. First, around 11:00 – 11:30PM, I found roughly 10% of office building parking lots with some lighting shut-off. From about 11:30 – 12:30AM, this number grew to about 56% as I traveled. I found many different methods that bi-level lighting was implemented. Some lighted only the driveway entrances and shut off the remainder of the fixtures. Some turned off one fixture on two fixture poles. Others turned off selected poles leaving others on. Still others provided lighting at the front of the building and turned off all other lighting. It was a mix of different implementations. In all cases, I observed the lighting level reduced by at least 50%, many were much lower. In my informal sampling, I did not include buildings where all outdoor lighting was on when there were cars in the parking lot and the buildings appeared to have some level of activity.

I found about 50% of the retail sites with some level of lighting shut off, or entirely off altogether. I observed a Mercedes dealership with all outdoor pole fixture lighting off except a couple of up lights on a few cars outside the showroom window. Other car dealerships had all lighting on, some had all front row lighting on while outdoor lighting levels were reduced in the interior and back of the sales lot. I also observed a high school parking lot with half the parking lot lighting turned off and two banks with all outdoor lighting on.

I guess if I were to draw some conclusions from my informal research it is as follows:

- Bi-level outdoor lighting in new construction design is common practice. It is seldom that engineers do not design for bi-level control of outdoor lighting and it appears many owners want it.
- When bi-level control is done, at least 50% of the lighting fixtures are shut-off. In some cases as much as 90% of the lighting is shut-off.
- Present practice of bi-level outdoor lighting does not follow even light distribution guidelines.
- Engineers and property managers feel there is a correlation between liability and reduced lighting levels. They design and use bi-level outdoor lighting control with these liability issues in mind.
- In practice, many existing sites use bi-level control of outdoor lighting when buildings are closed.

Hopefully this information is helpful in understanding how outdoor lighting control is presently

designed, installed and used. I would have to say that those who claim it can’t or shouldn’t be done are either using different data or haven't fully looked into the issue.

If you have any questions, please contact me at (925) 454-8225.

Sincerely,

Harold Jepsen P.E.
Electrical Engineer

CC: None **Fax #:**

File: outdoor bilevel research